PATENT ABSTRACTS OF JAPAN

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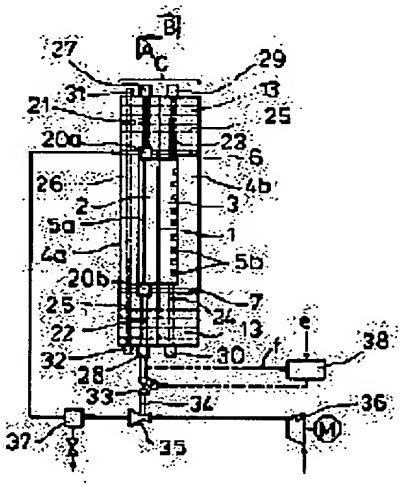
(71)Applicant : ISHIKAWAJIMA HARIMA HEAVY IND CO LTD
(72)Inventor : KOMAKI HIDEAKI

(54) SOLID HIGH POLYMER ELECTROLYTE FUEL CELL

(57)Abstract:
PURPOSE: To eliminate voltage-decreasing cells by discharging generated water in the cells effectively even when the stage number of the cells is increased for providing a large output, and provide the optimum control even in the case where the conditions of oscillation, acceleration, vibration, etc., are strict.
CONSTITUTION: Cells C comprising an electrolyte film 1 held by an oxygen electrode 2 and a fuel electrode 3 are parted by oxygen electrode side separators 4a and fuel electrode side separators 4b to be layered in multiple stages. Gas passages 5a, 5b are formed in the oxygen electrodes 2 and the fuel electrodes 3, so oxidizer gas is supplied/discharged through the gas passages 5a, while fuel gas is supplied/discharged through the gas passages 5b. The separators 4a, 4b are provided with external oxidizer gas/fuel gas supply/discharge passage holes 21, 22 and 23, 24, thereby generated water can be discharged from the oxidizer gas discharge passage holes by action of an ejector 35.



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CLAIMS

[Claim(s)]
[Claim 1] The polyelectrolyte film which made the front face support a platinum-electrode catalyst is inserted with the ring main diffusion electrode of an oxygen pole and a fuel electrode. While carrying out the laminating of the cel which turns oxidizer gas on an oxygen pole side, and has been made to carry out the feeding and discarding of the fuel gas to a fuel electrode side again, respectively to a multilayer through a separator In the solid-state polyelectrolyte mold fuel cell which is equipped with the cooling section for every number cel, and has been made into the stack The feed hopper and exhaust port for carrying out the feeding and discarding of oxidizer gas and the fuel gas to the separator by the side of the oxygen pole of the above-mentioned cel and the separator by the side of a fuel electrode from the exterior are prepared, respectively. The solid-state polyelectrolyte mold fuel cell characterized by having the configuration which prepared the feed hopper and exhaust port for making it open for free passage with the gas passageway of the polar zone, and carrying out the feeding and discarding of the cooling water for cel cooling to the separator by the side of an oxygen pole.
[Claim 2] The solid-state polyelectrolyte mold fuel cell according to claim 1 it was made to make the generation water in a cel discharge by connecting Rhine with a flow control valve to the exhaust port of the oxidizing agent gas formed in the oxygen pole side separator of each cel, attaching an ejector in this Rhine, and at least the water of the detection value of a cel electrical potential difference or the generation water in a cel adjusting the above-mentioned flow control valve with a controller based on a detection value, and letting a compressed air pass to an ejector.
[Claim 3] The solid-state polyelectrolyte mold fuel cell according to claim 1 which enabled it to supply a fuel as connected a hydrogen bomb or a reforming machine to Rhine linked to the feed hopper of the fuel gas formed in the fuel electrode side separator of each cel and adjusted with a controller the flow control valve prepared in above-mentioned Rhine based on the detection value of a cel electrical potential difference.
[Claim 4] Agitation, acceleration, an inclination, vibration, the solid-state polyelectrolyte mold fuel cell according to claim 3 that is made to perform optimum control of all the cels that are made to adjust a flow control valve with the controller using the electrical potential difference for every cel as a control signal, and constitute a stack.
[Claim 5] The solid-state polyelectrolyte mold fuel cell according to claim 1, 2, 3, or 4 which comes to form an electrode a direct gas passageway as metal.
[Claim 6] The solid-state polyelectrolyte mold fuel cell according to claim 1, 2, 3, or 4 which makes it come as a plank of a carbon plate to form an electrode a gas passageway in a separator.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to a solid-state polyelectrolyte mold fuel cell among the fuel cells which use the chemical energy which a fuel has in the energy section changed into direct electrical energy.
[0002]
[Description of the Prior Art] the generation-of-electrical-energy system using a solid-state polyelectrolyte mold fuel cell -- an automobile, an electric car, a vessel, a spacecraft, and deep sea -- development is advanced to the generation-of-electrical-energy facility, the ground generation-of-electrical-energy facility, etc. as an available thing.
[0003] The solid-state polyelectrolyte mold fuel cell proposed until now As an example is shown in drawing 7 thru/or drawing 9 , the laminating of the cel C which it comes to pile up across both sides of the electrolyte membrane 1 which made the front face support a platinum-electrode catalyst is carried out through a separator 4 with the ring main diffusion electrode of the oxygen pole 2 and a fuel electrode 3, and it is made to consider as a stack. A gas passageway 5 is formed in front flesh-side both sides at each separator 4, and it is oxidizer gas O2 in the oxygen pole 2 side. Feeding and discarding are carried out and it is fuel gas H2 in a fuel electrode 3 side. So that feeding and discarding may be carried out Each passage holes 6 and 7 of the for the object for supply of oxidizer gas, and for discharge to the periphery except the electrode reaction section of a center section, The object for supply of fuel gas and each passage holes 8 and 9 for discharge are formed, and oxidizer gas and fuel gas have been made to **** each gas passageway 5 on both sides of a separator 4. As shown in drawing 7 , a stack is pinched with end plates 10 and 11, and predetermined clamping force is given to the hole 13 prepared in the four-corners section through the ** bolt 12 with a bundle.
[0004] In the conventional solid-state polyelectrolyte mold fuel cell, after the gas supplied from the outside is humidified, it may be supplied, but since the reaction of a fuel cell is exothermic reaction, as the humidification section 14 is formed like drawing 7 , and there are some which were humidified before leading to the laminating section of the cel C which generates electricity, and it is shown in drawing 7 , the cooling section 15 is formed in every one number cel.
[0005] The flow of the cooling water supplied to the gas and the cooling section 15 which are supplied to the fuel electrode [of each above-mentioned cel C] 3, and oxygen pole 2 side (**) of drawing 9 , after fuel gas and oxidizer gas is also supplied from the separate inlet port of an end plate 10 and is humidified in the humidification section 14, as an example is shown in (**) (Ha) After the humidified gas flows the generation-of-electrical-energy cel section 16, it is made to be discharged from the outlet of an end plate 10 to the exterior. Cooling water After being supplied from the inlet port of an end plate 10 and cooling the generation-of-electrical-energy cel section 16, it is made to be discharged from the outlet of an end plate 10 to the exterior through the humidification section 14.
[0006] 17 are a fiber support to which SENTABUSU (+ pole) and 18 have rubber slab, and 19 has porosity among drawing.
[0007]
[Problem(s) to be Solved by the Invention] However, although it has possibility that-izing can be carried out [small lightweight] since current density can take the above-mentioned, conventional, very large solid-state polyelectrolyte mold fuel cell, it needs to make an electrical potential difference high for high-power-izing. for this reason -- being alike -- although the number of stages of a cel must be increased, since the electrical potential differences per one step of cel are 0.7-0.8V -- drawing 9 R>9 (**) -- there is an inclination for the die length of the generation-of-electrical-energy cel section 16 shown in (**) (Ha) to become long. When the die length of the generation-of-electrical-energy cel section 16 becomes long, like drawing 8 (b) (b) the feeding and discarding of gas On the configuration only by the passage holes 6 and 7 for the feeding and discarding of oxidizer gas, and the passage holes 8 and 9 for the feeding and discarding of fuel gas, Supply of the gas to each cel and discharge of the remaining gas, and discharge of the water generated by the oxygen pole 2 side become is hard to be performed appropriately, cooling becomes while there is a possibility of getting worse the property

of a cel, is hard to be carried out to homogeneity, and there is a possibility that a cel property may get worse with the ununiformity of temperature distribution. If the above-mentioned generation water is not discharged especially efficiently, blocking [supply and removal of concentration overvoltage, i.e., the reacting matter in an electrode, and a resultant stop going smoothly, and / the reaction of an electrode] ** will become large, and a cel electrical potential difference will fall. Moreover, when agitation, such as an automobile and a vessel, acceleration, an inclination, etc. apply to a severe thing, it is also considered that distribution of generation water differs for every cel, and generation water may pile up in some cels. In such a case, the electrical potential difference of the cel in which generation water piled up falls, and since the flow of gas is checked with the generation water which piled up, there is a possibility that the output distribution in a stack may also become an ununiformity.

[0008] Then, also when the conditions of agitation, acceleration, an inclination, etc. are severe, while the time of increasing and high-power-izing a cel number of stages, an automobile, a vessel, etc. enable it to perform appropriately supply of gas or hygroscopic moisture, and discharge of gas and generation water, this invention makes it easy to keep the temperature of the whole cel uniform, and it is going to make it aim at improvement in a property of a cel.

[0009]

[Means for Solving the Problem] In order that this invention may solve the above-mentioned technical problem, the polyelectrolyte film which made the front face support a platinum-electrode catalyst is inserted with the ring main diffusion electrode of an oxygen pole and a fuel electrode. While carrying out the laminating of the cel which turns oxidizer gas on an oxygen pole side, and has been made to carry out the feeding and discarding of the fuel gas to a fuel electrode side again, respectively to a multilayer through a separator In the solid-state polyelectrolyte mold fuel cell which is equipped with the cooling section for every number cel, and has been made into the stack The feed hopper and exhaust port for carrying out the feeding and discarding of oxidizer gas and the fuel gas to the separator by the side of the oxygen pole of the above-mentioned cel and the separator by the side of a fuel electrode from the exterior are prepared, respectively. It considers as the configuration which prepared the feed hopper and exhaust port for making it open for free passage with the gas passageway of the polar zone, and carrying out the feeding and discarding of the cooling water for cel cooling to the separator by the side of an oxygen pole.

[0010] Moreover, Rhine with a flow control valve is connected to the exhaust port of the oxidizer gas formed in the oxygen pole side separator of each cel. Attach an ejector in this Rhine and at least the water of the detection value of a cel electrical potential difference or the generation water in a cel adjusts the above-mentioned flow control valve with a controller based on a detection value. Make it make the generation water in a cel discharge by letting a compressed air pass to an ejector, or It can enable it to supply a fuel, as a hydrogen bomb or a reforming machine is connected to Rhine linked to the feed hopper of the fuel gas formed in the fuel electrode side separator of each cel and the flow control valve prepared in above-mentioned Rhine is adjusted with a controller based on the detection value of a cel electrical potential difference.

[0011] Furthermore, it may be made to be made to perform optimum control of all the cels that are made to adjust a flow control valve with agitation, acceleration, an inclination, vibration, and the controller using the electrical potential difference for every cel as a control signal, and constitute a stack.

[0012]

[Function] If generation water collects and the flow of gas is checked, since the electrical potential difference of the cel will fall, if it detects the electrical potential difference of a cel, or detects the water level of the generation water in a cel and is made to make generation water discharge positively, generation water can be discharged efficiently and sag and the ununiformity of output distribution can be prevented. Moreover, if inert gas is supplied to the passage of this cooling water with high pressure while the cooling water supplied from the outside of a cel can perform temperature control of a cel, it will become possible to prevent the leakage from the cel of oxidizer gas and fuel gas.

[0013] If fuel gas with high concentration is supplied to the fuel electrode side of the cel to which the electrical potential difference fell from the exterior The amount of the fuel gas of a cel with which concentration fell can be adjusted. Moreover, agitation, Based on acceleration, an inclination, vibration, the electrical potential difference for every cel, etc., all the cels of a stack are controllable by the command from a controller so that the property of the engine performance of a cel and the whole stack becomes best by adjusting the gas of an outlet side, and the amount of cooling water for every cel and every cel group.

[0014]

[Example] Hereafter, the example of this invention is explained with reference to a drawing.

[0015] Each of drawing 1 thru/or drawing 5 has the generation-of-electrical-energy cel section 16, the humidification section 14, and the cooling section 15 like the conventional method shown in drawing 7 as one example of this invention, and they have turned the laminating sideways. In the configuration by which the generation-of-electrical-energy cel section 16 ****, and it is made to be discharged in it since gas should pass the humidification section 14 What made the electrolyte membrane 1 the same magnitude as the oxygen pole 2

as a gas diffusion electrode and a fuel electrode 3, and prepared direct irregularity for these electrodes in this as metal, and formed the gas passageway is shown.
[0016] The solid-state polyelectrolyte film 1 which makes the front face have supported the platinum-electrode catalyst is inserted with the oxygen pole 2 and fuel electrode 3 of the same magnitude. Namely, to the tooth-back side of the oxygen pole 2 While forming irregularity in an a large number train and being referred to as gas-passageway 5a, to the tooth-back side of a fuel electrode 3 The irregularity of the a large number train prolonged in the direction which intersects perpendicularly with the above-mentioned gas-passageway 5a is formed. As gas-passageway 5b It is oxidizer gas O2 to the oxygen pole 2 side. It is fuel gas H2 to a fuel electrode 3 side again. One cel C which was made to carry out feeding and discarding, respectively It inserts by oxygen pole side separator 4a in which the crevice was formed in the center section of one side, and fuel electrode side separator 4b. An insulating material-cum-a sealant is made to intervene and it is made to carry out the seal of the peripheries of Separators 4a and 4b. To both the above-mentioned separators 4a and 4b Headers 20a and 20b and 20c and 20d are formed in the location of the both ends of each gas passagewaies 5a and 5b formed in electrodes 2 and 3, respectively. To oxygen pole side separator 4a As the supply passage hole 21 and the discharge passage hole 22 which can carry out the feeding and discarding of the oxidizer gas to the above-mentioned headers 20a and 20b from the exterior are shown in drawing 2 (b), while preparing, to fuel electrode side separator 4b It prepares, as the supply passage hole 23 and the discharge passage hole 24 which can carry out the feeding and discarding of the fuel gas to the above-mentioned headers 20c and 20d from the exterior are shown in drawing 2 (b).
[0017] moreover, to the separators 4a and 4b which pinch the one above-mentioned cel C While making it penetrate in the direction of a laminating respectively and forming two or more passage holes 6 for oxidizer gas supply, and the passage hole 7 for discharge Make it penetrate in the direction of a laminating respectively, and two or more passage holes 8 for fuel gas supply and the passage hole 9 for discharge are formed. In above-mentioned oxygen pole side separator 4a, the passage holes 6 and 7 for feeding and discarding of oxidizer gas are open for free passage with headers 20a and 20b, and the passage holes 8 and 9 for feeding and discarding of fuel gas are opened for free passage with headers 20c and 20d in above-mentioned fuel electrode side separator 4b.
[0018] Furthermore, while making it penetrate in the direction of a laminating and forming the cooling water passage hole 25, the cooling water passage hole 26 for cel cooling is formed in the above-mentioned oxygen pole side separator 4a and fuel electrode side separator 4b.
[0019] In addition, for the exhaust port of oxidizer gas, and 29, as for the exhaust port of fuel gas, and 31, the feed hopper of fuel gas and 30 are [27 / the feed hopper of oxidizer gas, and 28 / the feed hopper of cooling water and 32] the exhaust ports of cooling water, in addition the same sign is given to the same thing as drawing 7 thru/or drawing 9 .
[0020] The solid-state polyelectrolyte mold fuel cell of this invention is what carries out the laminating of the cel of a configuration of having mentioned above to a longitudinal direction multistage, and is made into a stack. Enable it to eliminate generation water positively for every cel by using the exhaust port 28 of the oxidizer gas for every above-mentioned cel, or By enabling it to perform control of the gas by agitation of an automobile, a vessel, etc., acceleration, the inclination, vibration, a cel electrical potential difference, etc., or water, or using the feed hopper 29 of the fuel gas to each cel for every cel and every cel group Control of fuel gas is able to adjust the amount of fuel gas or to be able to be made to perform as every cel, every cel group, and the whole stack.
[0021] Drawing 1 is what shows the example it is made to make generation water eliminate positively for every cel. Discharge Rhine 34 which has a flow control valve 33 on the way is connected to the exhaust port 28 of oxidizer gas. Attach an ejector 35 at the tip and it is made to make generation water discharge positively from the oxygen pole 2 side by the suction effect which produces the air compressed with the compressor 36 by letting the above-mentioned ejector 35 pass. And [whether after the air which made the above-mentioned ejector 35 drive removes moisture with the hygroscopic-moisture eliminator 37, it is made to make Cel C supply it directly as oxidizer gas, and] Or it is made to make it emit to atmospheric air, and the above-mentioned flow control valve 33 is calculated with a controller 38 based on the detection value e of the electrical potential difference for every cel, and the detection value f of the water level for every cel, and it is made to be further adjusted by the command from a controller 38.
[0022] Therefore, when it is going to eliminate now the water generated by the oxygen pole 2 side About the cel in which monitoring of a cel electrical potential difference and the water level for every cel was carried out, and the electrical potential difference fell extremely When it is the cause that make it decide the cause with a controller 38, and exclusion of generation water is not performed good, and when water level has become more than fixed level The flow control valve 33 made to connect to the exhaust port 28 of the oxidizing agent gas of the cel is opened, and an ejector 35 is made to drive and it is made to make generation water discharge by supplying a compressed air to an ejector 35 and passing it. Since the generation water in a cel is discharged good by this, the situation where the flow of gas is checked with generation water is avoided, and it becomes possible to raise the fuel utilization rate in a cel, and an oxidizer utilization factor.

[0023] Next, when performing optimum control of all the cels that constitute one stack, Agitation a, acceleration b, Inclination c, Vibration d, the electrical-potential-difference detection value e for every cel, etc. are inputted into a controller 38 as a control signal, and the discharge of gas or water is controlled by the command from a controller 38 using feedforward control or the various optimum control technique. In this case, although optimum control is difficult in controlling as the whole stack, optimal control as the whole stack can be performed like (b) of drawing 3 by performing control of gas or water for every cel, or being like (b) and being made to perform the cel of shoes as a group.
[0024] Drawing 4 is what shows the example which enabled it to adjust the amount of the hydrogen as fuel gas for every cel. The hydrogen bomb 40 or the reforming machine 41 is connected to the feed hopper 29 of the fuel gas of each cel through Rhine 39 at a fuel electrode 3 side. Input the detection value e of the electrical potential difference for every cel into a controller 38, and monitoring of the electrical potential difference for every cel is carried out. The gas which opened the flow control valve 43 about the cel to which the electrical potential difference fell, and removed CO by the CO stripper 42 out of the reformed gas from the hydrogen gas or the reforming machine 41 from a fuel 40, i.e., a hydrogen bomb, is supplied alternatively, and it is made to raise fuel concentration.
[0025] When load-effect width of face, such as an object for power, and fluctuation velocity are large, in a cel far from the cel near the end plate 10 shown in drawing 7 , a big difference may arise in a fuel temperature. If a high-concentration fuel is alternatively supplied to the cel to which fuel concentration has fallen and the electrical potential difference is falling by drawing 4 , it will become possible to raise load responsibility. Under the present circumstances, although it is also possible to keep the hygroscopic moisture in a cel the optimal by combining the moisture discharge method shown in drawing 1 and poisoning of the platinum catalyst supported by the solid-state polyelectrolyte film 1 is carried out to CO Instead of the reformed gas from the hydrogen gas or the reforming machine 41 from the hydrogen bomb 40 supplied from the feed hopper 29 of fuel gas, it is O2. It will be CO2 if it is made to make gas supply. It becomes possible to recover quickly the cel which could be carried out and carried out poisoning to CO. In drawing 4 , if a humidifier 44 is formed in the middle of Rhine 39 connected to the fuel gas feed hopper 29, it becomes possible to humidify and supply hydrogen gas or reformed gas, and the hygroscopic moisture in a cel can be adjusted.
[0026] The amount of supply of the fuel gas supplied to the fuel electrode side of each cel from the exterior like drawing 4 is controllable by signals, such as Agitation a, acceleration b, Inclination c, Vibration d, and the electrical-potential-difference detection value e of a cel, the optimal as a control signal. that drawing 5 indicates that example to be -- it is -- this case -- like (**) -- like every cel and (**) -- every cel group -- or (Ha) -- like -- it can be made to control as the whole stack
[0027] Next, drawing 6 shows other examples of this invention, and replaces the oxygen pole 2 and a fuel electrode 3 with said example of a configuration of having formed the irregularity for direct gas-passageway formation in this as metal. Since the activity which prepares the irregularity which considers as the perforated plate of one sheet which consists of carbon etc., and forms a direct gas passageway in this becomes serious, it is what prepares irregularity in the front face of Separators 4a and 4b, and formed gas passagewaies 5a and 5b, and other configurations are the same as that of the case of said example.
[0028] It can carry out like drawing 1 , drawing 3 , or drawing 5 R> 5, and can control also by the case of this example.
[0029] In addition, although the case where it humidified before supplying a cel was explained as an example after not limiting this invention only to the above-mentioned example and supplying [for example,] gas from the exterior Although the case where that you may make it supply the gas humidified with the external humidifier to a cel, oxidizer gas, and fuel gas were passed so that it may become cross flow was shown Although the case where for a gas passageway and the passage hole for gas feeding and discarding to be prepared and an electrolyte membrane 1 were made into the same magnitude as gas diffusion electrodes 2 and 3 was shown so that the flow direction of gas might serve as counterflow and a parallel current flow Although the thing which made it correspond to an electrode and made the crevice form in the front-face side of each [these] separators 4a and 4b was shown using oxygen pole side separator 4a and fuel electrode side separator 4b as that an electrolyte membrane 1 is good also as the same magnitude as Separators 4a and 4b, and a separator The part which arranges the oxygen pole 2 and a fuel electrode 3 may be made to form in the double-sided center section of the separator of one sheet, or you may make it make a gas passageway form. Of course, modification can be variously added within limits which do not deviate from the summary of considering as the configuration which formed the feed hopper 31 for carrying out the feeding and discarding of the cel cooling water, the exhaust port 32, and the cooling water passage hole 26 in the fuel electrode side separator, and other this inventions.
[0030]
[Effect of the Invention] As stated above, according to the solid-state polyelectrolyte mold fuel cell of this invention, an electrolyte membrane is inserted with the ring main diffusion electrode of an oxygen pole and a fuel electrode. In the configuration which carries out the laminating of the cel which was made to carry out the

feeding and discarding of the fuel gas to a fuel electrode side through a separator, and has been made to make it into the stack while being made to carry out the feeding and discarding of the oxidizer gas to an oxygen pole side While preparing the passage hole for feeding and discarding of the above-mentioned oxidizer gas in the above-mentioned oxygen pole and also being able to be made to carry out to an oxygen pole side the feeding and discarding of the oxidizer gas from the exterior for every cel Since it has considered as the cooling section which the feeding and discarding of the fuel gas could be similarly been made to carry out to a fuel electrode from the exterior, prepared the cooling water passage for making a cel carry out the feeding and discarding of the cooling water from the exterior further, and prepared this cooling water passage in the stack, and the configuration it was made open for free passage [configuration], the outstanding effectiveness like a degree can be done so.

(i) Since discharge Rhine is connected to the outlet of oxidizer gas established in the oxygen pole side and it is made to make generation water discharge positively, the situation where concentration overvoltage becomes large without discharging generation water good, a cel electrical potential difference falls, or the flow of gas is checked with generation water and the output distribution in a stack becomes an ununiformity can be prevented.

(ii) Load responsibility can be raised by making a high-concentration fuel supply alternatively in the cel in which the electrical potential difference fell since fuel gas was supplied from the feed hopper of the exterior to fuel gas to the cel to which fuel concentration fell although load responsibility worsened when the property of each [in a stack] cel changed a lot according to the fuel utilization rate and the ununiformity was in fuel concentration for every cel, and the electrical potential difference fell.

(iii) Since the feed hopper and exhaust port of cooling water are prepared for every cel or cel group in the separator By being able to perform temperature control for every cel or cel group, and passing inert gas with a pressure high a little from a fuel and oxidizer gas to cooling water passage It is also detectable by the ability protecting that fuel gas and oxidizing agent gas are revealed to the exterior not only from cooling of a cel but from a cel that fuel gas and oxidizing agent gas were revealed from the cel by always checking the component of this inert gas further.

(iv) Since it is made to control the gas for every cel and every cel group as the whole stack as the number of stages of a cel is increased and high power is obtained, it is effective because of a property improvement.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the cutting side elevation of one cel in which showing one example of this invention and showing the example which discharged generation water.
[Drawing 2] The cross section of drawing 1 is shown, (b) is A view Fig. and (b) is B view Fig.
[Drawing 3] It is a cutting side elevation in the case of the example which carries out the laminating of the cel of drawing 1 to multistage, and controls the gas by the side of an oxygen pole and the amount of generation water being shown, and controlling by a cutting side elevation in case (b) controls for every cel, and (b) making some cels a group.
[Drawing 4] It is the cutting side elevation showing the example which supplies a high-concentration fuel to the fuel electrode side of the cel of drawing 1 from the outside.
[Drawing 5] The cutting side elevation in the case of control of the amount of the fuel by the side of a fuel electrode being shown, and controlling by carrying out the laminating of the cel to multistage, and a cutting side elevation in case (**) controls for every cel, and (**) making some cels a group, and (Ha) are the cutting side elevations in the case of controlling as the whole stack.
[Drawing 6] It is the cutting side elevation of one cel showing other examples of this invention.
[Drawing 7] It is the outline cutting side elevation showing an example of the conventional solid-state polyelectrolyte mold fuel cell.
[Drawing 8] Drawing in which the transverse plane of the cel in drawing 7 is shown, and (b) shows a separator an oxygen pole side, and (b) are drawings showing a separator a fuel electrode side.
[Drawing 9] Drawing in which the example of the flow of each gas in the conventional example of drawing 7 and cooling water is shown, and (**) shows the flow of fuel gas, drawing in which (**) shows the flow of oxidizer gas, and (Ha) are drawings showing the flow of cooling water.
[Description of Notations]
1 Electrolyte Membrane
2 Oxygen Pole
3 Fuel Electrode
4a Oxygen pole side separator
4b Fuel electrode side separator
5a, 5b Gas passageway
15 Cooling Section
21 Oxidizer Gas Supply Passage Hole
22 Oxidizer Gas Discharge Passage Hole
23 Fuel Gas Supply Passage Hole
24 Fuel Gas Discharge Passage Hole
25 26 Cooling water passage hole
27 Feed Hopper of Oxidizer Gas
28 Exhaust Port of Oxidizer Gas
29 Feed Hopper of Fuel Gas
30 Exhaust Port of Fuel Gas
31 Feed Hopper of Cooling Water
32 Exhaust Port of Cooling Water
33 Flow Control Valve
34 Rhine (Discharge Rhine)
35 Ejector
38 Controller
39 Rhine
40 Hydrogen Bomb
41 Reforming Machine

43 Flow Control Valve
C Cel

[Translation done.]

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(71)出願人　000000099
石川島播磨重工業株式会社
東京都千代田区大手町２丁目２番１号

(72)発明者　駒木　秀明
東京都江東区豊洲二丁目１番１号　石川島播磨重工業株式会社東京第一工場内

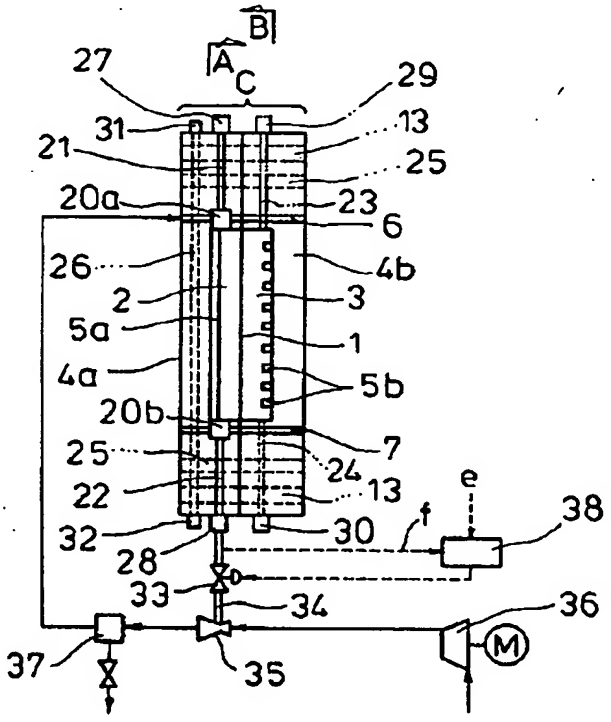
(74)代理人　弁理士　坂本　光雄

(54)【発明の名称】　固体高分子電解質型燃料電池

(57)【要約】

【目的】　大出力化のためセル段数を増やしてもセル内の生成水を効率よく排出して電圧が低下するセルをなくし、又、動揺、加速度、振動などの条件が厳しい場合でも最適制御ができるようにする。

【構成】　電解質膜１を酸素極２と燃料極３で挟んでなるセルＣを酸素極側セパレータ４ａと燃料極側セパレータ４ｂで仕切って多段に積層させる。酸素極２と燃料極３にガス通路５ａと５ｂを形成して、酸化剤ガスがガス通路５ａを、又、燃料ガスがガス通路５ｂをそれぞれ給排できるようにする。上記セパレータ４ａと４ｂに、上記ガス通路５ａと５ｂに別々に外部から酸化剤ガスと燃料ガスの給排流路孔２１，２２と２３，２４を設けて、生成水を酸化剤ガス排出流路孔よりエジェクタ３５の働きで排出させることを可能にする。



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【特許請求の範囲】

【請求項１】　表面に白金電極触媒を担持させた高分子電解質膜を酸素極と燃料極の両ガス拡散電極で挟み、酸素極側には酸化剤ガスを、又、燃料極側には燃料ガスをそれぞれ給排するようにしてあるセルをセパレータを介し多層に積層すると共に、数セルごとに冷却部を備えてスタックとしてある固体高分子電解質型燃料電池において、上記セルの酸素極側のセパレータと燃料極側のセパレータに、外部から酸化剤ガスと燃料ガスを給排するための供給口と排出口をそれぞれ設けて、電極部のガス通路と連通させ、且つ酸素極側のセパレータに、セル冷却用の冷却水を給排するための供給口と排出口を設けた構成を有することを特徴とする固体高分子電解質型燃料電池。

【請求項２】　各セルの酸素極側セパレータに設けた酸化剤ガスの排出口に流量調節弁付きのラインを接続し、該ラインにエジェクタを取り付け、上記流量調節弁を、セル電圧の検出値又はセル内の生成水の水位検出値に基づき制御器により調節するようにし、圧縮空気をエジェクタに通すことによりセル内の生成水を排出させるようにした請求項１記載の固体高分子電解質型燃料電池。

【請求項３】　各セルの燃料極側セパレータに設けた燃料ガスの供給口に接続したラインに水素ボンベ又は改質器を接続し、上記ラインに設けた流量調節弁を、セル電圧の検出値に基づき制御器により調節するようにして、燃料を供給できるようにした請求項１記載の固体高分子電解質型燃料電池。

【請求項４】　動揺、加速度、傾斜、振動、セルごとの電圧を制御信号として用いる制御器により流量調節弁を調節させてスタックを構成する全セルの最適制御を行うようにする請求項３記載の固体高分子電解質型燃料電池。

【請求項５】　電極を金属製として直接ガス通路を形成してなる請求項１、２、３又は４記載の固体高分子電解質型燃料電池。

【請求項６】　電極をカーボン板の一枚板としてセパレータにガス通路を形成させてなる請求項１、２、３又は４記載の固体高分子電解質型燃料電池。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は燃料の有する化学エネルギーを直接電気エネルギーに変換するエネルギー部門で用いる燃料電池のうち、固体高分子電解質型燃料電池に関するものである。

【０００２】

【従来の技術】固体高分子電解質型燃料電池を用いた発電システムは、自動車、電車、船舶、宇宙船、深海発電設備、地上発電設備等に利用可能なものとして開発が進められている。

【０００３】これまでに提案されている固体高分子電解質型燃料電池は、図７乃至図９に一例を示す如く、表面に白金電極触媒を担持させた電解質膜１の両面を酸素極２と燃料極３の両ガス拡散電極で挟んで重ね合わせてなるセルＣをセパレータ４を介し積層してスタックとするようにし、各セパレータ４には、表裏両面にガス通路５を形成して、酸素極２側には酸化剤ガスO_2を給排し、又、燃料極３側には燃料ガスH_2を給排するように、中央部の電極反応部を除く周辺部に酸化剤ガスの供給用及び排出用の各流路孔６及び７と、燃料ガスの供給用及び排出用の各流路孔８及び９を設けて、酸化剤ガスと燃料ガスがセパレータ４を挟んでそれぞれのガス通路５を流配されるようにしてあり、図７に示す如く、スタックをエンドプレート１０及び１１で挟持し、四隅部に設けた孔１３に締付用ボルト１２を通して所定の締付力を付与するようにしてある。

【０００４】従来の固体高分子電解質型燃料電池では、外部から供給するガスは加湿されてから供給される場合もあるが、図７の如く加湿部１４を設けて、発電を行うセルＣの積層部に導く前に加湿するようにしたものもあり、又、燃料電池の反応は発熱反応であるため、図７に示す如く、数セルに１つずつ冷却部１５が設けられている。

【０００５】上記各セルＣの燃料極３側及び酸素極２側へ供給されるガス及び冷却部１５へ供給される冷却水の流れは、図９の（イ）（ロ）（ハ）に一例を示すように、燃料ガスも酸化剤ガスもエンドプレート１０の別々の入口から供給されて加湿部１４で加湿された後、加湿されたガスが発電セル部１６を流れてからエンドプレート１０の出口から外部へ排出されるようにしてあり、冷却水は、エンドプレート１０の入口から供給されて発電セル部１６を冷却した後、加湿部１４を経てエンドプレート１０の出口から外部へ排出されるようにしてある。

【０００６】図中、１７はセンタータブス（＋極）、１８はゴムパッド、１９は多孔になっているファイバーサポートである。

【０００７】

【発明が解決しようとする課題】ところが、上記従来の固体高分子電解質型燃料電池は、電流密度が非常に大きくとれるため、小型軽量化できる可能性を持っているが、大出力化のためには、電圧を高くする必要がある。このためにはセルの段数を増やさなければならないが、セル１段当りの電圧が０．７～０．８Ｖであるので、図９（イ）（ロ）（ハ）に示す発電セル部１６の長さが長くなる傾向がある。発電セル部１６の長さが長くなると、図８（イ）（ロ）の如くガスの給排を、酸化剤ガスの給排用の流路孔６，７及び燃料ガスの給排用の流路孔８，９のみによっている構成上、各セルへのガスの供給及び残りのガスの排出や、酸素極２側で生成された水の排出が適切に行われにくくなって、セルの特性を悪化するおそれがあると共に、冷却が均一に行われにくくな

り、温度分布の不均一によりセル特性が悪化するおそれがある。特に、上記生成水が効率よく排出されないと、濃度過電圧、すなわち、電極における反応物質及び反応生成物の補給及び除去が円滑に行かなくなり電極の反応が妨害されること、が大きくなり、セル電圧が低下する。又、自動車や船舶等、動揺や加速度、傾斜等が厳しいものに適用する場合、生成水の分布がセルごとに異なることも考えられ、生成水が一部のセルに滞留する可能性がある。このような場合、生成水の滞留したセルの電圧が低下し、又、滞留した生成水によりガスの流れが阻害されるため、スタック内の出力分布も不均一になるおそれがある。

【０００８】そこで、本発明は、セル段数を増やして大出力化したときや、自動車や船舶等、動揺、加速度、傾斜等の条件が厳しい場合も、ガスや湿分の供給やガス、生成水の排出を適切に行えるようにすると共に、セル全体の温度を一様に保つことを容易にしてセルの特性向上を図るようにしようとするものである。

【０００９】

【課題を解決するための手段】本発明は、上記課題を解決するために、表面に白金電極触媒を担持させた高分子電解質膜を酸素極と燃料極の両ガス拡散電極で挟み、酸素極側には酸化剤ガスを、又、燃料極側には燃料ガスをそれぞれ給排するようにしてあるセルをセパレータを介し多層に積層すると共に、数セルごとに冷却部を備えてスタックとしてある固体高分子電解質型燃料電池において、上記セルの酸素極側のセパレータと燃料極側のセパレータに、外部から酸化剤ガスと燃料ガスを給排するための供給口と排出口をそれぞれ設けて、電極部のガス通路と連通させ、且つ酸素極側のセパレータに、セル冷却用の冷却水を給排するための供給口と排出口を設けた構成とする。

【００１０】又、各セルの酸素極側セパレータに設けた酸化剤ガスの排出口に流量調節弁付きのラインを接続し、該ラインにエジェクタを取り付け、上記流量調節弁を、セル電圧の検出値又はセル内の生成水の水位検出値に基づき制御器により調節するようにし、圧縮空気をエジェクタに通すことによりセル内の生成水を排出させるようにしたり、各セルの燃料極側セパレータに設けた燃料ガスの供給口に接続したラインに水素ボンベ又は改質器を接続し、上記ラインに設けた流量調節弁を、セル電圧の検出値に基づき制御器により調節するようにして、燃料を供給できるようにしたりすることができる。

【００１１】更に、動揺、加速度、傾斜、振動、セルごとの電圧を制御信号として用いる制御器により流量調節弁を調節させてスタックを構成する全セルの最適制御を行うようにするようにしてもよい。

【００１２】

【作用】生成水が溜って来てガスの流れが阻害されると、そのセルの電圧が低下して来るので、セルの電圧を検出したり、セル内の生成水の水位を検出して生成水を積極的に排出させるようにすると、生成水を効率よく排出できて電圧低下や出力分布の不均一を防止することができる。又、セルの外部から供給する冷却水によりセルの温度制御を行うことができると共に、この冷却水の流路に不活性ガスを高圧で供給すると、酸化剤ガス及び燃料ガスのセルからの漏洩を防止することが可能となる。

【００１３】電圧が低下したセルの燃料極側へ濃度の高い燃料ガスを外部より供給すると、濃度が低下したセルの燃料ガスの量を調節することができ、又、動揺、加速度、傾斜、振動、セルごとの電圧等を基に制御器からの指令でスタックの全セルをセルごと又はセルグループごとに出口側のガス、冷却水の量を調節することにより、セルの性能、スタック全体の特性が最良になるように制御することができる。

【００１４】

【実施例】以下、本発明の実施例を図面を参照して説明する。

【００１５】図１乃至図５はいずれも本発明の一実施例として、図７に示した従来方式と同様に発電セル部１６と加湿部１４と冷却部１５を有して横に積層してあり、ガスが加湿部１４を経てから発電セル部１６に流配されて排出されるようにしてある構成において、電解質膜１をガス拡散電極としての酸素極２と燃料極３と同じ大きさとし且つこれら電極を金属製としてこれに直接凹凸を設けてガス通路を形成したものについて示す。

【００１６】すなわち、表面に白金電極触媒を担持させてある固体高分子電解質膜１を同じ大きさの酸素極２と燃料極３で挟み、酸素極２の背面側には、多数列に凹凸を形成してガス通路５ａとすると共に、燃料極３の背面側には、上記ガス通路５ａと直交する方向に延びる多数列の凹凸を形成してガス通路５ｂとして、酸素極２側に酸化剤ガスO_2を、又、燃料極３側に燃料ガスH_2をそれぞれ給排させるようにした１つのセルＣを、片面の中央部に凹部を形成した酸素極側セパレータ４ａと燃料極側セパレータ４ｂとで挟み、セパレータ４ａと４ｂの周辺部同士を絶縁材兼シール材を介在させてシールさせるようにし、且つ上記両セパレータ４ａと４ｂには、電極２，３に形成された各ガス通路５ａと５ｂの両端部の位置にヘッダー部２０ａ，２０ｂと２０ｃ，２０ｄをそれぞれ形成し、酸素極側セパレータ４ａには、上記ヘッダー部２０ａと２０ｂに外部から酸化剤ガスを給排できる供給流路孔２１と排出流路孔２２を図２（イ）に示す如く設けると共に、燃料極側セパレータ４ｂには、上記ヘッダー部２０ｃと２０ｄに外部から燃料ガスを給排できる供給流路孔２３と排出流路孔２４を図２（ロ）に示す如く設ける。

【００１７】又、上記１つのセルＣを挟持するセパレータ４ａと４ｂには、複数個の酸化剤ガス供給用流路孔６と排出用流路孔７を各々積層方向に貫通させて設けると

共に、複数個の燃料ガス供給用流路孔８と排出用流路孔９を各々積層方向に貫通させて設け、上記酸素極側セパレータ４ａでは酸化剤ガスの給排用流路孔６，７がヘッダー部２０ａ，２０ｂと連通し、又、上記燃料極側セパレータ４ｂでは燃料ガスの給排用流路孔８，９がヘッダー部２０ｃ，２０ｄと連通するようにしてある。

【００１８】更に、上記酸素極側セパレータ４ａと燃料極側セパレータ４ｂには、冷却水流路孔２５を積層方向に貫通させて設けると共に、セル冷却用の冷却水流路孔２６を設ける。

【００１９】なお、２７は酸化剤ガスの供給口、２８は酸化剤ガスの排出口、２９は燃料ガスの供給口、３０は燃料ガスの排出口、３１は冷却水の供給口、３２は冷却水の排出口であり、その他図７乃至図９と同一のものには同一符号が付してある。

【００２０】本発明の固体高分子電解質型燃料電池は、上述した構成のセルを横方向に多段に積層してスタックとするもので、上記各セルごとの酸化剤ガスの排出口２８を利用することにより、各セルごとに生成水を積極的に排除できるようにしたり、各セルごとやセルグループごとに、自動車や船舶等の動揺、加速度、傾斜、振動、セル電圧等によるガス又は水の制御を行うことができるようにしたり、又は各セルへの燃料ガスの供給口２９を利用することにより、燃料ガスの量を調節するようにしたり、各セルごと、セルグループごと、あるいはスタック全体として燃料ガスのコントロールができるようにすることが可能である。

【００２１】図１は各セルごとに生成水を積極的に排除させるようにする実施例を示すもので、酸化剤ガスの排出口２８に、途中に流量調節弁３３を有する排出ライン３４を接続して、その先端にエジェクタ３５を取り付け、圧縮機３６で圧縮された空気を上記エジェクタ３５を通すことにより生じる吸引作用で酸素極２側から生成水を積極的に排出させるようにし、且つ上記エジェクタ３５を駆動させた空気は、湿分分離器３７で水分を除いた後、酸化剤ガスとしてセルＣに直接供給させるようにするか、あるいは、大気に放出させるようにし、更に、上記流量調節弁３３は、セルごとの電圧の検出値ｅとセルごとの水位の検出値ｆに基づき制御器３８で演算されて制御器３８からの指令により調節されるようにしてある。

【００２２】したがって、今、酸素極２側で生成された水を排除しようとするときは、セル電圧及びセルごとの水位をモニタリングし、電圧が極端に下がったセルについては、その原因を制御器３８で確定するようにし、生成水の排除が良好に行われていないことが原因の場合及び水位が一定レベル以上になっている場合は、そのセルの酸化剤ガスの排出口２８に連絡させた流量調節弁３３を開き、エジェクタ３５に圧縮空気を供給して通過させることによりエジェクタ３５を駆動させ、生成水を排出

させるようにする。これによりセル内の生成水が良好に排出されるので、ガスの流れが生成水により阻害されるという事態が避けられ、セル内の燃料利用率、酸化剤利用率を上昇させることが可能となる。

【００２３】次に，１つのスタックを構成する全セルの最適制御を行うときは、制御器３８に、制御信号として動揺ａ、加速度ｂ、傾斜ｃ、振動ｄ、セルごとの電圧検出値ｅ、等を入力するようにし、フィードフォワード制御や各種最適制御手法を用いて、制御器３８からの指令でガス又は水の排出量を制御するようにする。この場合、スタック全体として制御するのでは最適制御は難しいが、図３の（イ）の如く各セルごとにガス又は水の制御を行ったり、（ロ）の如くいくつかのセルをグループとして行うようにすることにより、スタック全体としての最適な制御を行うことができることになる。

【００２４】図４は各セルごとに燃料ガスとしての水素の量を調節できるようにした例を示すもので、各セルの燃料ガスの供給口２９にライン３９を介して燃料極３側に水素ボンベ４０又は改質器４１を接続し、セルごとの電圧の検出値ｅを制御器３８に入力してセルごとの電圧をモニタリングし、電圧の低下したセルについて流量調節弁４３を開いて燃料、すなわち、水素ボンベ４０からの水素ガス又は改質器４１からの改質ガス中よりＣＯ除去装置４２でＣＯを除去したガスを選択的に供給して燃料濃度を上昇させるようにする。

【００２５】動力用等負荷変動幅や変動速度が大きいものの場合、図７に示すエンドプレート１０に近いセルと遠いセルでは燃料温度に大きな差が生じる可能性がある。燃料濃度が下がっていて電圧が低下しているセルに図４により選択的に高濃度の燃料を供給するようにすれば、負荷応答性を向上させることが可能となる。この際、図１に示す水分排出方式を組み合わせることによりセル内の湿分を最適に保つことも可能であり、又、固体高分子電解質膜１に担持される白金触媒は、ＣＯに被毒されるが、燃料ガスの供給口２９より供給する水素ボンベ４０からの水素ガス又は改質器４１からの改質ガスの代りに、O_2 ガスを供給させるようにすれば、CO_2 にすることができてＣＯに被毒したセルを急速に回復させることが可能となる。　図４において、燃料ガス供給口２９に接続されるライン３９の途中に加湿器４４を設けると、水素ガス又は改質ガスを加湿して供給することが可能となり、セル内の湿分を調節することができる。

【００２６】各セルの燃料極側へ図４のように外部より供給する燃料ガスの供給量を、制御信号として動揺ａ、加速度ｂ、傾斜ｃ、振動ｄ、セルの電圧検出値ｅ等の信号により最適に制御することができる。図５はその例を示すもので、この場合、（イ）の如く各セルごと、（ロ）の如くセルグループごと、あるいは（ハ）の如くスタック全体として制御させることができる。

【００２７】次に、図６は本発明の他の実施例を示すも

ので、酸素極２及び燃料極３を金属製としてこれに直接ガス通路形成用の凹凸を形成した構成の前記実施例に代えて、カーボン等からなる一枚の多孔板とし、且つこれには直接ガス通路を形成する凹凸を設ける作業が大変となるので、セパレータ４ａと４ｂの表面に凹凸を設けてガス通路５ａ，５ｂを形成するようにしたもので、その他の構成は前記実施例の場合と同様である。

【００２８】この実施例の場合でも、図１、図３乃至図５のようにして制御することができる。

【００２９】なお、本発明は上記実施例のみに限定されるものではなく、たとえば、ガスを外部より供給した後、セルへ供給する前に加湿する場合を例として説明したが、外部の加湿器で加湿したガスをセルに供給するようにしてもよいこと、酸化剤ガスと燃料ガスを直交流となるように流す場合を示したが、ガスの流れ方向が対向流、並行流となるようにガス通路、ガス給排用流路孔を設けてもよいこと、電解質膜１をガス拡散電極２，３と同じ大きさとした場合を示したが、電解質膜１はセパレータ４ａ，４ｂと同じ大きさとしてもよいこと、セパレータとして、酸素極側セパレータ４ａと燃料極側セパレータ４ｂを用いて、これら各セパレータ４ａ，４ｂの表面側に電極に対応させて凹部を形成させたものを示したが、１枚のセパレータの両面中央部に酸素極２と燃料極３を配置する部分を形成させたり、ガス通路を形成させるようにしてもよいこと、セル冷却水を給排するための供給口３１、排出口３２、冷却水流路孔２６を燃料極側セパレータに設けた構成とすること、その他本発明の要旨を逸脱しない範囲内で種々変更を加え得ることは勿論である。

【００３０】

【発明の効果】以上述べた如く、本発明の固体高分子電解質型燃料電池によれば、電解質膜を酸素極と燃料極の両ガス拡散電極で挟み、酸素極側に酸化剤ガスを給排させるようにすると共に燃料極側に燃料ガスを給排させるようにしたセルをセパレータを介し積層してスタックとするようにしてある構成において、上記酸素極に、上記酸化剤ガスの給排用流路孔を設けるほかに、各セルごとに外部から酸素極側に酸化剤ガスを給排できるようにすると共に、燃料極にも、同様に外部から燃料ガスを給排できるようにし、更に、セルに外部から冷却水を給排させるための冷却水流路を設け、該冷却水流路をスタック内に設けた冷却部と連通するようにした構成としてあるので、次の如き優れた効果を奏し得る。

(i) 酸素極側に設けた酸化剤ガスの出口に排出ラインを接続して生成水を積極的に排出させるようにするので、生成水が良好に排出されないで濃度過電圧が大きくなりセル電圧が低下したり或は生成水によりガスの流れが阻害されてスタック内の出力分布が不均一になるという事態を防止できる。

(ii)スタックにおける各セルの特性は、燃料利用率によって大きく変わり、各セルごとに燃料濃度に不均一があると、負荷応答性が悪くなるが、燃料濃度が下がって電圧の低下したセルに対して外部から燃料ガスの供給口より燃料ガスを供給することができるので、電圧の下がったセルに選択的に高濃度の燃料を供給させることにより負荷応答性を向上させることができる。

(iii) セパレータ内にセル又はセル群ごとに冷却水の供給口及び排出口を設けているので、セル又はセル群ごとに温度制御を行うことができ、又、冷却水流路に、燃料及び酸化剤ガスより若干圧力の高い不活性ガスを流すことにより、セルの冷却のみでなく、セルから外部へ燃料ガス及び酸化剤ガスが漏洩することを防ぐことができ、更に、この不活性ガスの成分を常時チェックすることにより燃料ガス及び酸化剤ガスがセルから漏洩したことを検知することもできる。

(iv)セルの段数を増やして大出力が得られるようにして、スタック全体としてセルごと及びセルグループごとのガスの制御を行うようにするので、特性改善のために有効である。

【図面の簡単な説明】

【図１】本発明の一実施例を示すもので、生成水を排出するようにした例を示す１つのセルの切断側面図である。

【図２】図１の断面を示すもので、（イ）はＡ矢視図、（ロ）はＢ矢視図である。

【図３】図１のセルを多段に積層して酸素極側のガス及び生成水の量の制御を行う例を示すもので、（イ）は各セルごとに制御を行う場合の切断側面図、（ロ）はいくつかのセルをグループとして制御を行う場合の切断側面図である。

【図４】図１のセルの燃料極側へ高濃度の燃料を外部から供給する例を示す切断側面図である。

【図５】セルを多段に積層して燃料極側への燃料の量の制御について示すもので、（イ）は各セルごとに制御を行う場合の切断側面図、（ロ）はいくつかのセルをグループとして制御を行う場合の切断側面図、（ハ）はスタック全体として制御を行う場合の切断側面図である。

【図６】本発明の他の実施例を示す１つのセルの切断側面図である。

【図７】従来の固体高分子電解質型燃料電池の一例を示す概略切断側面図である。

【図８】図７におけるセルの正面を示すもので、（イ）は酸素極側とセパレータを示す図、（ロ）は燃料極側とセパレータを示す図である。

【図９】図７の従来例における各ガスと冷却水の流れの例を示すもので、（イ）は燃料ガスの流れを示す図、（ロ）は酸化剤ガスの流れを示す図、（ハ）は冷却水の流れを示す図である。

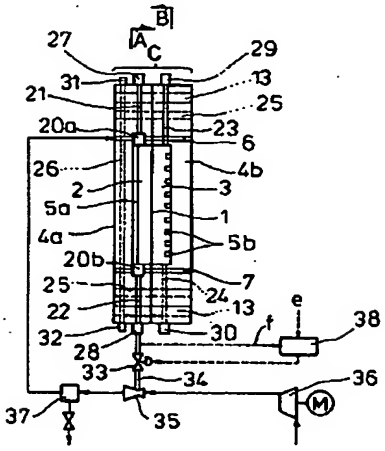
【符号の説明】

１　電解質膜

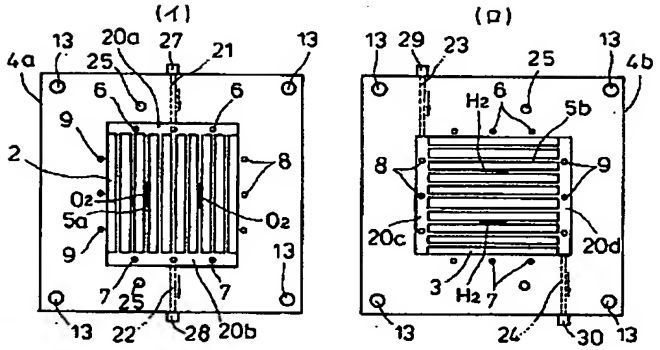
9　　10

２　酸素極
３　燃料極
４ａ　酸素極側セパレータ
４ｂ　燃料極側セパレータ
５ａ，５ｂ　ガス通路
１５　冷却部
２１　酸化剤ガス供給流路孔
２２　酸化剤ガス排出流路孔
２３　燃料ガス供給流路孔
２４　燃料ガス排出流路孔
２５，２６　冷却水流路孔
２７　酸化剤ガスの供給口
２８　酸化剤ガスの排出口
２９　燃料ガスの供給口
３０　燃料ガスの排出口
３１　冷却水の供給口
３２　冷却水の排出口
３３　流量調節弁
３４　ライン（排出ライン）
３５　エジェクタ
３８　制御器
３９　ライン
４０　水素ボンベ
４１　改質器
４３　流量調節弁
Ｃ　セル

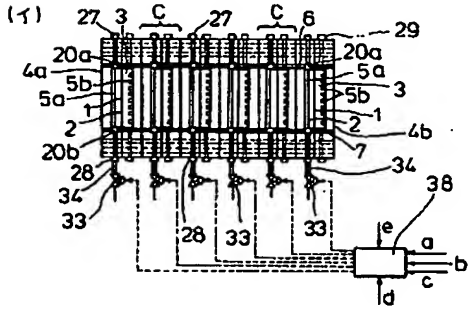
【図１】



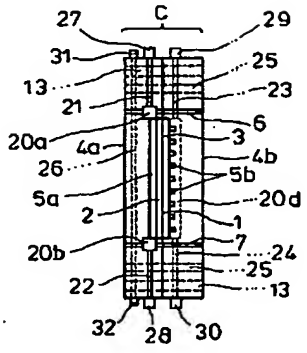
【図２】



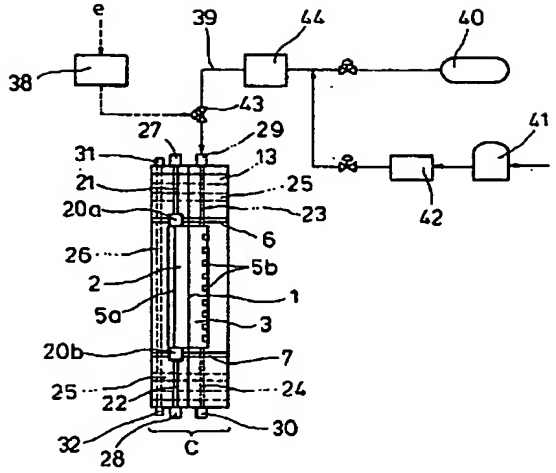
【図３】



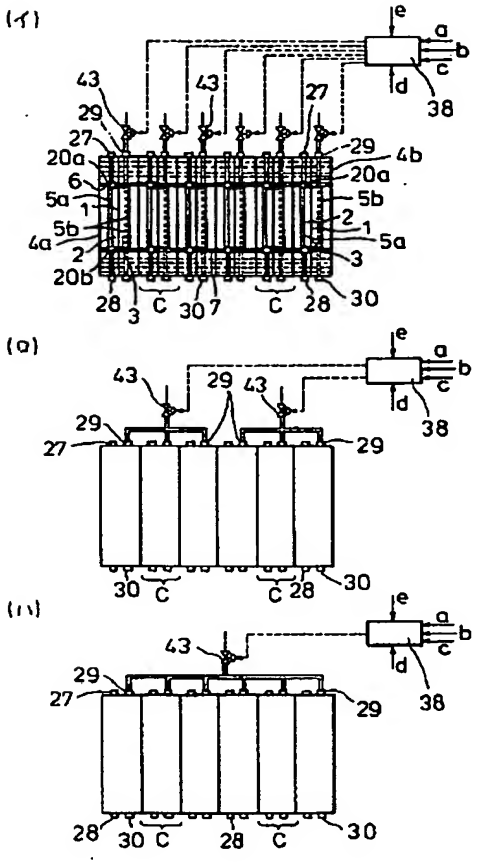
【図６】



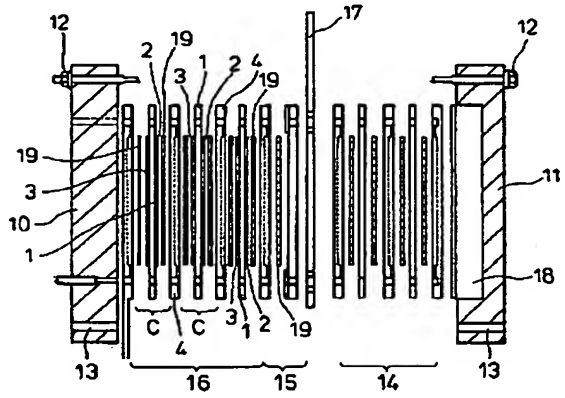
【図４】


e
39
44
40
38
43
41
27
29
31
13
21
25
20a
23
42
6
26
5b
2
1
5a
3
20b
7
25
22
24
32
28
30
C

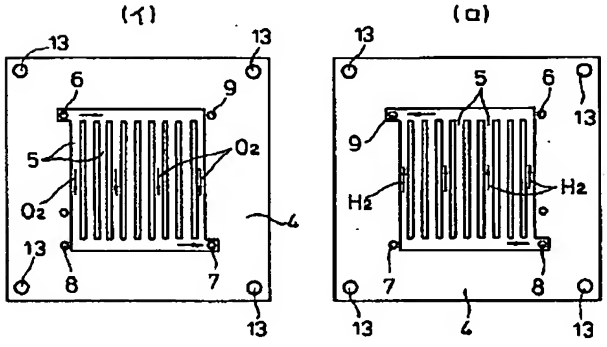
【図５】


(イ)
e
a
b
c
d
38
43
29
27
20a
6
5a
1
5b
4a
2
20b
4b
3
28
C
30
7
(ロ)
(ハ)

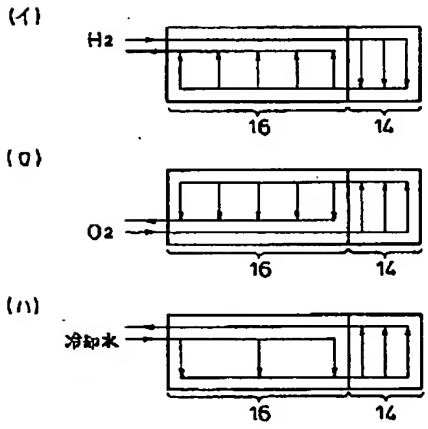
【図７】


12
17
2
19
3
1
4
10
11
18
C
16
15
14
13

【図８】


(イ)
(ロ)
13
6
9
5
O2
H2
8
7
4

【図９】


(イ)
H2
16
14
(ロ)
O2
(ハ)
冷却水

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